A Wavelet-based Algorithm for Delineation and Classification of ECG Waves

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Quantitative analysis of the electrocardiogram (ECG) requires delineation of the individual ECG waves. Fiducial points are important markers that can be used in clinical practice to guide diagnosis. We therefore propose a robust delineation algorithm to identify important onsets, offsets and peaks for the P, QRS, J, and T-wave. Furthermore, we investigated whether the identified fiducial points could be used to classify the configuration of a given wave i.e negative, positive, biphasic or absent. Annotated ECG records (n=105) of the QT database (Physionet) were used in this study and all ECG waves were classified manually according to their configuration. A quadratic spline wavelet was used to identify fiducial points. These fiducial points were subsequently used to automatically determine the configuration of the individual waves in the ECG. The difference between annotated and automatically identified points was calculated and the accuracy for correct wave configuration was determined. Classification accuracy for wave configurations were: 74% (P-wave), 94% (QRS complex) and 82% (T-wave). The average difference between manual and automatic delineation of the P-wave (onset/offset) was -5.6 ms (std. = 26.7 ms). For points involved in the QRS complex this difference was -1.2 ms (12.2 ms) on average. The difference between automatic and annotated T-wave (peak and offset) was 1.8 ms (32.5 ms). We have shown that it was possible to use automatically identified fiducial points for classification of wave configurations. This technique may potentially be used to assist clinicians in identifying abnormal beat configurations in long term Holter recordings.